

MATERIAL SAFETY DATA SHEET

1. SUBSTANCE AND SOURCE IDENTIFICATION

National Institute of Standards and Technology
Standard Reference Materials Program
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SRM Number: 3124a
MSDS Number: 3124a
SRM Name: Indium Standard Solution

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Description: This Standard Reference Material (SRM) is intended for use as a primary calibration standard for the quantitative determination of indium. Each unit consists of five 10 mL sealed borosilicate glass ampoules of an acidified aqueous solution prepared gravimetrically to contain a nominal 10 mg/g of indium. The addition of indium to nitric acid forms indium nitrate, which will precipitate upon evaporation or drying of the solution; thus, the mixture has three components.

Material Name: Indium Standard Solution

Other Designations:

Indium: In

Indium Nitrate: Indium trinitrate; indium (III) nitrate; nitric acid, indium (3+) salt.

Nitric acid: Aqua fortis; hydronitrate; azotic acid; engraver's acid.

2. COMPOSITION AND INFORMATION ON HAZARDOUS INGREDIENTS

| Component | CAS Registry | EC Number (EINECS) | Concentration (%) |
|----------------|--------------|--------------------|-------------------|
| Nitric Acid | 7697-37-2 | 231-714-2 | 10 |
| Indium Nitrate | 13770-61-1 | 237-393-5 | 2.6 |
| Indium | 7440-74-6 | 231-180-0 | 1 |

EC Classification, R/S Phrases: Refer to Section 15, Regulatory Information.

3. HAZARDS IDENTIFICATION

NFPA Ratings (Scale 0-4): Health = 4 Fire = 0 Reactivity = 2

Major Health Hazards: Nitric acid can cause severe or fatal burns if inhaled, swallowed, or absorbed through the skin. Indium and indium nitrate can cause severe irritation and tissue destruction by the same routes of exposure. Indium can also damage the liver, heart, and kidneys.

Physical Hazards: The glass container may shatter. Protect from physical damage and heat.

Potential Health Effects

| | |
|----------------------|--|
| Inhalation: | Nitric acid, if inhaled, can damage the mucous membranes and upper respiratory tract, causing spasm, inflammation of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Symptoms may include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting. Inhalation of indium dust or indium nitrate can cause severe irritation and damage to the upper respiratory tract. Occupational exposure to indium (mainly by inhalation) may be associated with an excess risk of tooth decay, joint pain, and disorders of the nervous system and GI tract. Indium has caused birth defects in animals. |
| Skin Contact: | Nitric acid can cause severe skin burns. Effects of acid burns may be delayed. Indium or indium nitrate may be absorbed through the skin, causing the effects described for inhalation or ingestion. Indium nitrate can also cause severe skin irritation and tissue damage. |
| Eye Contact: | Nitric acid can cause severe eye irritation, corneal burns, permanent eye damage, or blindness. Indium nitrate solutions are also corrosive and may cause eye damage. Indium dust can cause mechanical irritation. |
| Ingestion: | Nitric acid can cause severe burns and damage to the GI tract. Indium and its compounds are poorly absorbed from the GI tract, but ingestion of a large dose can cause abdominal pain, vomiting, and diarrhea. Prolonged exposure can damage the liver, heart, or kidneys. Indium has caused birth defects in animals. |

Medical Conditions Aggravated by Exposure: None documented for this mixture. Both nitric acid and indium nitrate may aggravate pre-existing disorders of the respiratory tract, skin, and eyes. Indium may aggravate disorders of the liver, heart, kidneys, or other target organs. Pregnant women should avoid exposure to indium.

Listed as a Carcinogen/ Potential Carcinogen:

| | Yes | No |
|--|-------|--------------|
| In the National Toxicology Program (NTP) Report on Carcinogens | _____ | <u> X </u> |
| In the International Agency for Research on Cancer (IARC) Monographs | _____ | <u> X </u> |
| By the Occupational Safety and Health Administration (OSHA) | _____ | <u> X </u> |

4. FIRST AID MEASURES

Inhalation: Move the person to fresh air immediately. Qualified medical personnel may start CPR or give oxygen if necessary. Get medical aid at once, and bring the container or label.

Skin Contact: Remove contaminated clothing and shoes. Flush affected skin with water for at least 1 minute, then wash thoroughly with soap and water. If burns are severe or if skin irritation persists, get medical aid and bring the container or label. Wash contaminated clothing before reusing.

Eye Contact: Remove contact lenses (if any). Do not allow victim to rub eyes or keep eyes closed. Flush eyes with large amounts of running water for at least 30 minutes, keeping eyelids open and raising lids to remove all chemical. Get medical aid at once, and bring the container or label.

Ingestion: Contact a poison control center immediately for instructions. Wash out mouth with water, but do not induce vomiting. Get medical aid at once, and bring the container or label.

Note to Physician (Nitric Acid): Wash affected skin with 5% solution of sodium bicarbonate (NaHCO₂). Activated charcoal is of no value. Do not give bicarbonate to neutralize the material.

5. FIRE FIGHTING MEASURES

Fire and Explosion Hazards: Although nitric acid does not burn, it is a powerful oxidizing agent that can react with combustible materials to cause fires. Indium nitrate is also an oxidizer. Finely divided indium metal dust or powder may be flammable or explosive. Indium reacts vigorously with some incompatible materials (Section 10).

Extinguishing Media: Use extinguishing media appropriate to the surrounding fire: water spray, dry chemical, carbon dioxide, or foam. Use a water spray to dilute nitric acid and to absorb liberated oxides of nitrogen. (These guidelines apply to the mixture; when the components are considered separately, different precautions may apply.)

Fire Fighting: Avoid inhalation of material or combustion byproducts. Wear full protective clothing and NIOSH-approved self-contained breathing apparatus (SCBA).

Flash Point (°C): N/A

Autoignition (°C): N/A

Flammability Limits in Air: N/A

Lower Explosive Limit (LEL): N/A

Upper Explosive Limit (UEL): N/A

Flammability Class (OSHA): N/A

Products of Combustion: Thermal decomposition of nitric acid can release nitrogen oxides, including nitric oxide (NO), nitrogen dioxide (NO₂), and nitrous oxide (N₂O), as well as nitric acid mist or vapor. Thermal decomposition of indium nitrate may also release nitrogen oxides and other hazardous products. Indium oxide (In₂O₃) fumes may be released when indium is heated.

6. ACCIDENTAL RELEASE MEASURES

Occupational Release: Notify safety personnel of spills. Surfaces contaminated with this material should be covered with soda ash or sodium bicarbonate to neutralize the acid. Place the neutralized material into containers suitable for eventual disposal, reclamation, or destruction.

Disposal: Refer to Section 13, Disposal Considerations.

7. HANDLING AND STORAGE

Storage: Store unopened containers of this material in a dry place with acid-resistant flooring at room temperature. Protect from physical damage, heat, and light, and isolate from incompatible materials.

Safe Handling Precautions: Wear gloves and chemical safety goggles (Section 8). Engineering controls should maintain airborne concentrations below TLV (Section 8).

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

Nitric Acid:

ACGIH TLV-TWA: 5 mg/m³

NIOSH/OSHA TLV-TWA: 5 mg/m³

Indium Nitrate:ACGIH TLV-TWA: 0.1 mg/m³NIOSH/OSHA TLV-TWA: 0.1 mg/m³**Indium:**ACGIH TLV-TWA: 0.1 mg/m³NIOSH/OSHA TLV-TWA: 0.1 mg/m³

Ventilation: Use local or general exhaust to keep employee exposures below limits. Local exhaust ventilation is preferred because it can control contaminant emissions at the source, preventing dispersion into the general work area. Refer to the ACGIH document *Industrial Ventilation, a Manual of Recommended Practices*.

Respirator: If necessary, refer to the NIOSH document *Guide to the Selection and Use of Particulate Respirators Certified under 42 CFR 84* for selection and use of respirators certified by NIOSH.

Eye Protection: Use chemical safety goggles where dusting or splashing of solutions may occur. See OSHA standard (29 CFR 1910.133) or European Standard EN166. The employer should provide an emergency eye wash fountain and safety shower in the immediate work area.

Personal Protection: Wear appropriate gloves and protective clothing to prevent contact with skin.

9. PHYSICAL AND CHEMICAL PROPERTIES

| Nitric Acid | Indium Nitrate | Indium |
|---|---|--|
| Appearance and Odor: Colorless to slightly yellow liquid, darkens to brown upon aging and exposure to light; irritating, pungent odor. | Appearance and Odor: White crystals. | Appearance and Odor: Soft, white metal with a bluish tinge. |
| Relative Molecular Weight: 63.02 | Relative Molecular Weight: 300.84 | Relative Atomic Weight: 114.82 |
| Molecular Formula: HNO ₃ | Molecular Formula: In(NO ₃) ₃ | Molecular Formula: In |
| Specific Gravity: 1.0543 (10%) | Specific Gravity: N/A | Specific Gravity: 7.3 |
| Solvent Solubility: Decomposes in alcohol | Solvent Solubility: Soluble in alcohol. | Solvent Solubility: Soluble in acids and alcohol. |
| Water Solubility: Soluble | Water Solubility: Highly soluble | Water Solubility: Insoluble |
| Boiling Point (°C): 86 (187°F) | Boiling Point (°C): N/A | Boiling Point (°C): 2072 (3761°F) |
| Melting Point (°C): -42 (-43.6°F) | Melting Point (°C): 100 (212°F) | Melting Point (°C): 156 (313°F) |
| Vapor Pressure (Pa): 946 @20°C | Vapor Pressure (Pa): Negligible | Vapor Pressure (Pa): Negligible |
| Vapor Density (Air=1): 2.17 | Vapor Density (Air=1): N/A | Vapor Density (Air=1): N/A |
| Critical Solution Temperature: N/A | Critical Solution Temperature: N/A | Critical Solution Temperature: N/A |
| pH: 1.0 (0.1M solution) | pH: N/A | pH: N/A |

NOTE: The physical and chemical data provided are for the pure components. No physical or chemical data are available for this solution of indium, indium nitrate, and nitric acid. The actual behavior of the solution may differ from the individual components.

10. STABILITY AND REACTIVITY

Stability: X Stable Unstable

Stable at normal temperatures and pressure.

Conditions to Avoid: Incompatible materials.

Incompatible Materials:

Nitric Acid: Incompatible with numerous materials including organic materials, plastics, rubber, chlorine, and metal ferrocyanide.

Indium and Indium Nitrate: Incompatible with combustible materials, strong bases, mineral acids, oxidizing materials, carbonates, lithium, sulfur dioxide, halogens, peroxides, and metals. An explosive reaction may occur if indium comes in contact with dinitrogen tetroxide and acetonitrile. Indium also reacts vigorously with mercury (II) bromide at 350°C. Mixtures of indium and sulfur may ignite when heated.

Fire/Explosion Information: See Section 5.

Hazardous Decomposition: Thermal decomposition of nitric acid can release nitrogen oxides, including nitric oxide (NO), nitrogen dioxide (NO₂), and nitrous oxide (N₂O), as well as nitric acid mist or vapor. Thermal decomposition of indium nitrate may also release nitrogen oxides and other hazardous products. Indium oxide (In₂O₃) fumes may be released when indium is heated.

Hazardous Polymerization: Will Occur X Will Not Occur

11. TOXICOLOGICAL INFORMATION

Route of Entry: X Inhalation X Skin X Ingestion

Nitric Acid:

Human, oral: LD_{Lo} = 430 mg/kg

Rat, oral: LD₅₀ > 90 mg/kg

Rat, inhalation: LC₅₀ (4 hrs) = 130 mg/m³

Indium Nitrate:

Mouse, oral: LD₅₀ = 3300 mg/kg

Mouse, intraperitoneal: LD_{Lo} = 100 mg/kg

Indium:

Rat, oral: LD₅₀ = 10 mg/kg

Target Organ(s):

Nitric Acid: skin, teeth, eyes, respiratory tract.

Indium and Indium Nitrate: liver, heart, kidneys, skin, respiratory tract.

Mutagen/Teratogen: Nitric acid has caused birth defects in animals under experimental conditions, and has been investigated as a possible mutagen. Indium and indium nitrate have caused fetal damage in rats.

Health Effects: See Section 3.

12. ECOLOGICAL INFORMATION

Nitric Acid:

Green shore crab (*Carcinus maenas*): LC₅₀ (48 hrs) = 180,000 µg/L
Starfish (*Asterias rubens*): LC₅₀ (48 hrs) = 100,000 to 330,000 µg/L
Hooknose (*Agonus cataphractus*): LC₅₀ (48 hrs) = 100,000 to 330,000 µg/L
Brook trout (*Salvelinus fontinalis*): NR-LETH = 1,562 µg/L
Cockle (*Cerastoderma edule*): LC₅₀ (48 hrs) = 330,000 to 1,000,000 µg/L

Indium Nitrate: No ecotoxicity data were found for this compound. Due to the ionic nature of metal salts, this material is expected to adsorb to soil as well as suspended solids and sediment in water. Indium nitrate (as nitric acid, indium [3+] salt, CAS 13770-61-1) is one of several indium compounds removed from the EPA's Priority Testing List in 2002 due to a lack of production or importation data.

Indium: Since indium metal is not water soluble, its bioavailability is limited. No ecotoxicity data were found. As of October 2005, indium remains on the EPA's Priority Testing List.

Environmental Summary: The mixture is expected to be slightly toxic to aquatic life. The environmental effects of indium have not been fully evaluated.

13. DISPOSAL CONSIDERATIONS

Waste Disposal: One or more components of this mixture is a RCRA hazardous waste. Dispose of container and unused contents in accordance with federal, state, and local requirements for acid waste, which vary according to location. Decontaminate containers before recycling. Processing, use, or contamination of this product may change the waste management options.

14. TRANSPORTATION INFORMATION

U.S. DOT and IATA:

Nitric Acid: Hazard Class 8, UN2031, Packing Group II, Packing Inst. 807 (Excepted Qty)

15. REGULATORY INFORMATION

U.S. REGULATIONS

CERCLA Sections 102a/103 (40 CFR 302.4):

Indium and Indium Nitrate: Not regulated.
Nitric Acid: RQ = 1000 lbs.

SARA Title III Section 302: Nitric acid is regulated.

SARA Title III Section 304: Nitric acid is regulated.

SARA Title III Section 313: Nitric acid is regulated.

OSHA Process Safety (29 CFR 1910.119): Nitric acid at higher concentrations (≥ 94.5%) is regulated.

SARA Title III Sections 311/312 Hazardous Categories (40 CFR 370.21):

| | |
|-----------------|-----|
| ACUTE: | Yes |
| CHRONIC: | Yes |
| FIRE: | No |
| REACTIVE: | Yes |
| SUDDEN RELEASE: | No |

STATE REGULATIONS

California Proposition 65: None of the components are regulated.

CANADIAN REGULATIONS

WHMIS Classification:

Nitric Acid: C (oxidizing material), D1A (very toxic material), E (corrosive material)
Indium Nitrate: D2B (material causing other toxic effects), E (corrosive material)
Indium: D2B (material causing other toxic effects)

WHMIS Ingredient Disclosure List: All three components are regulated.

CEPA Domestic Substances List (DSL): All three components are regulated.

EUROPEAN REGULATIONS

EU/EC Classification:

Nitric Acid: O (Oxidizer), C (Corrosive)

Indium Nitrate: Xi (Irritant); not listed in Annex I of Directive 67/548/EEC.

Indium: XN (Harmful); not listed in Annex I of Directive 67/548/EEC.

Risk Phrases (mixture):

R23 (toxic by inhalation)
R25 (toxic if swallowed)
R35 (causes severe burns)
R36/37/38 (irritating to eyes, respiratory system and skin)

Safety Phrases (mixture):

S20/21 (when using, do not eat, drink or smoke)
S28 (wash after contact with skin)
S45 (in case of accident or illness, see doctor; show label)
S60 (dispose of this material and its container as hazardous waste)

NATIONAL INVENTORY STATUS

U.S. Inventory (TSCA): All components are listed.

TSCA 12(b), Export Notification: No components are listed.

16. OTHER INFORMATION

Sources:

Amdur M.O., et al., *Casarett and Doull's Toxicology: The Basic Science of Poisons*. 4th Ed. New York: McGraw-Hill, 1993.

Criteria Group for Occupational Standards, Scientific Basis for Swedish Occupational Standards. XV. Consensus report for indium and inorganic indium compounds. *Arbete Och Hälsa* 1994; 30:52-55.

Hazardous Substances Data Bank (HSDB): Indium and Indium Compounds.

IUCLID Dataset: Nitric Acid. European Commission, European Chemicals Bureau, 19 February 2000.

Nakajima M, et al., Teratogenic effects of indium by oral or intravenous administration in rats. *Teratology* 1998 Mar; 57(3):19A.

PAN Pesticide Database: Nitric Acid.

U.S. Environmental Protection Agency, Fifty-Sixth Report of the TSCA Interagency Committee to the Administrator of the Environmental Protection Agency. *Federal Register* Vol. 70, No. 204, 24 Oct 2005.

U.S. National Institute for Occupational Safety and Health, *NIOSH Pocket Guide to Chemical Hazards*, June 1990 edition. DHHS (NIOSH) Publication No. 90-117.

U.S. National Institute of Standards and Technology, *Certificate of Analysis: Standard Reference Material® 3124a, Indium Standard Solution*. 26 October 2004.

Disclaimer: Physical and chemical data contained in this MSDS are provided only for use as a guide in assessing the hazardous nature of the material. The MSDS was prepared carefully, using current references; however, NIST does not certify the data in the MSDS. The certified values for this material are given in the NIST Certificate of Analysis.